

| ABBREVIATIONS |                       | DUCT SYSTEM INSTALLATION   |                                     | MAIN RESIDENCE RADIANT DESIGN SUMMARY  |       |                    |                    |             |           |           |             |                    |   |  |           | RADIANT HEATING NOTES   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
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| AC            | AIR CONDITIONING UNIT | M  | MOTOR                               | <p>1. Duct installation shall be in conformance with chapter 6 of the 2007 CMC or as recommended by ACCA manuals D, E, G, and I; smacna manuals, and/or the ASHRAE handbook if approved by official having jurisdiction. Care shall be exercised to seal all joints and seams to prevent air leakage.</p> <p>2. Where shown on the mechanical plan and if necessary for other locations, provide rectangular duct of equivalent cross section area to the round duct shown to clear obstructions. Provide smooth transitions when the duct shape changes.</p> <p>3. Flexible vibration isolation connectors shall be installed in sheet metal ductwork at the unit in both the supply and air intake; these shall not exceed 10 inches in length. Duct work shall be properly aligned at these connectors without any offset.</p> <p>4. Metal ductwork shall be installed in a workman-like manner in accordance with acceptable practice given in the ASHRAE handbook or the SMACNA "low pressure duct construction standards" manual. Sheet metal ducts shall be at least the minimum thickness required for their large st dimension and/or the static pressure to which they shall be subjected. They shall be provided with turning vanes or long radius bends both to reduce the pressure loss and to provide a more uniform velocity distribution downstream from the bend. All duct seams and joints shall be airtight and sealed tightly. These shall be sealed with products such as mastic and/or foil-backed tape recommended by the manufacturer and shall be applied by a certified installer.</p> <p>5. Rigid ductwork exposed to view shall be installed in such a manner as to present a neat appearance. The ducts shall be parallel to adjacent architectural surfaces and have a few joints as possible.</p> <p>6. All metal ducts shall be securely supported, hung, or suspended by metal hangers, straps, or brackets and the support material in contact with the duct, or external insulation, shall not be less than 0.75 inches wide. The hanger spacing shall be no greater than 18 inches. Hangers shall be provided with a minimum of 1/2 inch clearance between the duct and the support material. Hangers shall be provided for rectangular ducts up to 24 inches or wider, and for round ducts shall be cross broken or headed to provide additional support. Ducts shall be insulated with fiberglass duct insulation to provide a minimum duct insulation value of 4.2. Wye branches and diffuser boots shall be insulated on their exterior surfaces unless they are exposed to the weather, are exposed to view, or could be damaged during occupancy of the building. Any insulating material used shall meet the appropriate specifications required by ASTM E-84, c-553, NEPA 900, and UL 181. Such insulation shall have 100% coverage and be installed in accordance with the manufacturer's instructions.</p> <p>7. Flexible air duct shall be UL listed class 1 air duct made with a polyvinyl interior, a moisture impervious sleeve and insulation having an overall <math>R</math>-value no less than 4.2. Flexed covered duct shall be used in locations where high radiant heat loads may be expected. Performance and assembly shall be in strict accordance with details listed in the flexible ductwork manufacturer's application manual or the SMACNA "Flexible duct performance standards and flexible duct insulation standards". Tight turns and abrupt changes in direction shall be avoided. Ducts shall be sealed to prevent air leakage. Particular attention shall be taken to avoid kinks, sharp bends, or other such obstructions in the duct. Factory-made flexible air ducts shall be installed according to their installation instructions and standards set by the code. Duct work shall use pressure-sensitive tapes, mastic, aerosol sealants or other closure systems meeting applicable UL 181A and B requirements. Drybands used with flexible ducts shall be either stainless-steel, worn driven hose clamps or self-expanding duct bands. In addition, drybands must have a minimum tensile strength rating of 15 pounds per square inch and a minimum elongation of 10%.</p> <p>8. Flexible duct shall be supported at the manufacturer's recommended intervals but in no case shall the intervals between hangers exceed 4.0 ft. The hanger material shall not be less than 2.0 inch wide. The maximum permissible sag shall be 0.5 inch per foot of spacing between supports. Collars shall be used to attach flexible duct and shall be a minimum of 2.0 inches in length. Collars shall be inserted into the flexible duct a minimum of 1.0 inch before fastening.</p> <p>9. Reach accessible balancing or volume control dampers with outside locking devices shall be provided as shown on the mechanical plans and/or as needed to regulate the air flow to each register.</p> <p>10. Supply and return plenums shall be covered with insulation having a value of 4.2 or greater on their internal surfaces. Any insulating material used shall meet the appropriate specifications required by ASTM E-84, c-553, NEPA 900, and UL 181. Such insulation shall have 100% coverage and be installed in accordance with the manufacturer's instructions.</p> <p>11. Ductwork shall be installed so that it will not contact the ground.</p> <p>12. Return air grill may be substituted, as desired, based on equal face area.</p> <p>13. Boot area shall match grill area in all cases. If necessary, boots should be lined with acoustical lining to reduce noise transmission.</p> <p>14. Plenum shall be lined with acoustical lining.</p> <p>15. Flat ducts for wall registers shall be 3-1/4" x 14" unless shown on the plans.</p> <p>16. Termination of horizontal air ducts including direct vent elimination kits shall be a minimum of 3 feet from or open air into the building (i.e., dryers, bath and utility fans, etc.) must be 3 feet away from doors, windows, opening skylights or attic vents.</p> <p>Gas lines</p> <p>1. Piping shall be new, standard weight wrought iron or steel (exterior-only galvanized or black), with malleable iron fittings. Approved PE (polyethylene) pipe may be used in exterior buried piping systems.</p> <p>2. Exterior piping shall be protected by approved, machine applied protective coating. Field wrapping shall be limited to sections at joints and shall provide equivalent protection to the machine applied coating.</p> <p>3. Gas lines may not be installed on or under the ground under buildings; they must be at least 6 inches above the ground.</p> <p>4. Gas lines shall be wrapped with insulation and steamed where passing through concrete. Piping shall be protected where passing through framing using metal straps designed for the purpose.</p> <p>MAJOR EQUIPMENT INSTALLATION</p> <p>1. Installation shall meet all local and national codes pertaining to the installation and operation of plumbing equipment. Unless otherwise required by these standards, the equipment shall be installed in accordance with the equipment manufacturers' recommendations.</p> <p>2. If "or equal" equipment is to be used, it must meet the performance specifications for the equipment listed, and shall be supplied by the manufacturer or by the mechanical engineer. All requests for substitution shall be furnished with current engineering data to demonstrate that the proposed equipment fulfills all the performance levels of the equipment originally specified. The contractor shall be responsible for all costs associated with the engineering for structural, electrical, duct sizing, etc. Caused by any substitution.</p> <p>3. Units shall be installed to provide the clearance or clearance specified by the manufacturer or required by the authority having jurisdiction.</p> <p>4. Units shall be surface support to prevent transmission of objectionable noise or vibration generated by the equipment to the structure. Outdoor ground mounted units shall be located on a level, one piece, concrete pad.</p> <p>5. Provide and install low voltage control wiring in conduit installed by the mechanical or plumbing contractor using methods contained in the electrical specifications. All wiring of line voltage controls to be accomplished by the electrical contractor.</p> <p>6. Contractors shall co-ordinate with the electrical contractor to ensure that all electrical accessories such as motor starters, control relays, circuit breakers, etc. Required to make a fully functional systems are provided.</p> |       |                    |                    |             |           |           |             |                    |   |  |           | <p><b>Project Summary</b></p> <p><b>Project #:</b> 12-144<br/> <b>Project Name:</b> Tomlin Residence<br/> <b>Total Loops:</b> 25<br/> <b>Total Zones:</b> 5<br/> <b>Total Panel Area:</b> 4,204 ft<sup>2</sup></p> <p><b>Total Flowrate:</b> 10.1 USGPM<br/> <b>Maximum Head Loss:</b> 3.5 ft(H2O)<br/> <b>Total Manifolds:</b> 5<br/> <b>Min. Tubing Required:</b> 5421 ft<br/> <b>Total Radiant Load:</b> 65,341 Btu/hr</p> |          | <p><b>GENERAL INFORMATION</b></p> <p>1. It is the installer's responsibility to assure the system functions properly, safely, and meets all local, state and regional codes.</p> <p>2. Installer to supply and install all materials shown on this plan and all others needed to complete this hydronic system. Also, provide any incidental work not shown or specified, which can be reasonable inferred as belonging to the work necessary to provide the complete system.</p> <p>3. This plan does not constitute a complete installation guide for a hydronic system. The installer shall be factory trained, properly licensed and reasonably experienced in the installation of hydronic heating systems. RPA and I-B-I installation procedures and recommendations shall be followed in reflecting the installation.</p> <p>4. Coordinate with General Contractor and the work of all other trades.</p> <p>5. Work shall comply with requirements of building inspectors and all local, state and federal codes, including UBC, UMC, IPC, UFC, UL, NEC, and OSHA. Installation of equipment and materials shall comply with manufacturer's installation instructions and industry standards.</p> <p>6. The Monterey Energy Group Inc. makes no guarantee for any material or components to be installed in this hydronic system.</p> |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>Radiant Design Data</b></p> <table border="1"> <thead> <tr> <th colspan="2">Manifold 1</th> <th colspan="10">Flow Rate: 1.1 USGPM</th> </tr> <tr> <th>Room</th> <th>Zone</th> <th>Attachment Method</th> <th>Tube Type</th> <th>Loop Number</th> <th>Area</th> <th>Unit Heat</th> <th>Spacing Leader</th> <th>Loop Length</th> <th>Flow Rate</th> <th>Head Loss</th> <th>Valve Turns</th> <th>Cover R.V.</th> <th>Surface Temp.</th> <th>Water Temp.</th> <th>Temp Drop</th> </tr> </thead> <tbody> <tr> <td>Game Room</td> <td>1</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>1</td> <td>173.3</td> <td>21.0</td> <td>9</td> <td>3</td> <td>237</td> <td>0.6</td> <td>2.9</td> <td>4.2</td> <td>0.5</td> <td>78.5</td> <td>98.5</td> <td>15</td> </tr> <tr> <td>Game Room</td> <td>1</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>2</td> <td>173.0</td> <td>21.0</td> <td>9</td> <td>3</td> <td>237</td> <td>0.6</td> <td>2.9</td> <td>4.2</td> <td>0.5</td> <td>78.5</td> <td>98.5</td> <td>15</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Manifold 2</th> <th colspan="10">Flow Rate: 3.2 USGPM</th> </tr> <tr> <th>Room</th> <th>Zone</th> <th>Attachment Method</th> <th>Tube Type</th> <th>Loop Number</th> <th>Area</th> <th>Unit Heat</th> <th>Spacing Leader</th> <th>Loop Length</th> <th>Flow Rate</th> <th>Head Loss</th> <th>Valve Turns</th> <th>Cover R.V.</th> <th>Surface Temp.</th> <th>Water Temp.</th> <th>Temp Drop</th> </tr> </thead> <tbody> <tr> <td>Bed 4</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>1</td> <td>138</td> <td>16.0</td> <td>9</td> <td>3</td> <td>190</td> <td>0.3</td> <td>0.5</td> <td>2.91</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> <tr> <td>Bed 4</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>2</td> <td>138</td> <td>16.0</td> <td>9</td> <td>3</td> <td>190</td> <td>0.3</td> <td>0.9</td> <td>2.91</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> <tr> <td>Dining Room</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>3</td> <td>186</td> <td>12.0</td> <td>9</td> <td>3</td> <td>254</td> <td>0.3</td> <td>1.2</td> <td>3.89</td> <td>0.5</td> <td>74</td> <td>86.5</td> <td>15</td> </tr> <tr> <td>Entry</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>4</td> <td>186</td> <td>12.0</td> <td>9</td> <td>3</td> <td>254</td> <td>0.3</td> <td>1.2</td> <td>3.89</td> <td>0.5</td> <td>74</td> <td>86.5</td> <td>15</td> </tr> <tr> <td>Kitchen</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>5</td> <td>147</td> <td>16.0</td> <td>9</td> <td>3</td> <td>202</td> <td>0.4</td> <td>1.1</td> <td>3.11</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> <tr> <td>Laundry</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>6</td> <td>171</td> <td>16.0</td> <td>9</td> <td>3</td> <td>234</td> <td>0.4</td> <td>1.7</td> <td>3.59</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> <tr> <td>Family</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>7</td> <td>201</td> <td>16.0</td> <td>9</td> <td>3</td> <td>274</td> <td>0.5</td> <td>2.6</td> <td>4.2</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> <tr> <td>Family</td> <td>2</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>8</td> <td>201</td> <td>16.0</td> <td>9</td> <td>3</td> <td>274</td> <td>0.5</td> <td>2.6</td> <td>4.2</td> <td>0.5</td> <td>76</td> <td>91.8</td> <td>15</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th colspan="2">Manifold 3</th> <th colspan="10">Flow Rate: 1.4 USGPM</th> </tr> <tr> <th>Room</th> <th>Zone</th> <th>Attachment Method</th> <th>Tube Type</th> <th>Loop Number</th> <th>Area</th> <th>Unit Heat</th> <th>Spacing Leader</th> <th>Loop Length</th> <th>Flow Rate</th> <th>Head Loss</th> <th>Valve Turns</th> <th>Cover R.V.</th> <th>Surface Temp.</th> <th>Water Temp.</th> <th>Temp Drop</th> </tr> </thead> <tbody> <tr> <td>Entry</td> <td>3</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>1</td> <td>117</td> <td>15.0</td> <td>9</td> <td>3</td> <td>162</td> <td>0.3</td> <td>0.5</td> <td>2.98</td> <td>0.5</td> <td>75.5</td> <td>90.5</td> <td>15</td> </tr> <tr> <td>Living Room</td> <td>3</td> <td>Embedded</td> <td>PEX 1/2"</td> <td>2</td> <td>166.5</td> <td>15.0</td> <td>9</td> <td>3</td> <td>228</td> <td>0.4</td> td&gt; </tr> </tbody> </table> |                                     |  |       |                    |                    |             |           |           |             |                    |   | Manifold 1   |           | Flow Rate: 1.1 USGPM  |          |  |                |                              |                                     |         |                  |                              |                                     | Room               | Zone             | Attachment Method      | Tube Type                           | Loop Number | Area             | Unit Heat                    | Spacing Leader                      | Loop Length | Flow Rate        | Head Loss                    | Valve Turns                         | Cover R.V. | Surface Temp. | Water Temp. | Temp Drop   | Game Room | 1      | Embedded | PEX 1/2" | 1    | 173.3 | 21.0 | 9    | 3     | 237 | 0.6  | 2.9  | 4.2 | 0.5  | 78.5 | 98.5   | 15  | Game Room | 1  | Embedded | PEX 1/2"   | 2  | 173.0 | 21.0 | 9    | 3    | 237 | 0.6   | 2.9  | 4.2    | 0.5 | 78.5  | 98.5 | 15    | Manifold 2 |    | Flow Rate: 3.2 USGPM |     |      |      |     |   |      |         |    |       | Room | Zone  | Attachment Method | Tube Type | Loop Number | Area | Unit Heat | Spacing Leader | Loop Length | Flow Rate  | Head Loss | Valve Turns | Cover R.V. | Surface Temp. | Water Temp. | Temp Drop | Bed 4 | 2  | Embedded | PEX 1/2" | 1    | 138 | 16.0 | 9  | 3 | 190 | 0.3 | 0.5 | 2.91 | 0.5 | 76 | 91.8 | 15 | Bed 4 | 2 | Embedded | PEX 1/2" | 2 | 138 | 16.0 | 9 | 3 | 190 | 0.3 | 0.9 | 2.91 | 0.5 | 76 | 91.8 | 15 | Dining Room | 2 | Embedded | PEX 1/2" | 3 | 186 | 12.0 | 9 | 3 | 254 | 0.3 | 1.2 | 3.89 | 0.5 | 74 | 86.5 | 15 | Entry | 2 | Embedded | PEX 1/2" | 4 | 186 | 12.0 | 9 | 3 | 254 | 0.3 | 1.2 | 3.89 | 0.5 | 74 | 86.5 | 15 | Kitchen | 2 | Embedded | PEX 1/2" | 5 | 147 | 16.0 | 9 | 3 | 202 | 0.4 | 1.1 | 3.11 | 0.5 | 76 | 91.8 | 15 | Laundry | 2 | Embedded | PEX 1/2" | 6 | 171 | 16.0 | 9 | 3 | 234 | 0.4 | 1.7 | 3.59 | 0.5 | 76 | 91.8 | 15 | Family | 2 | Embedded | PEX 1/2" | 7 | 201 | 16.0 | 9 | 3 | 274 | 0.5 | 2.6 | 4.2 | 0.5 | 76 | 91.8 | 15 | Family | 2 | Embedded | PEX 1/2" | 8 | 201 | 16.0 | 9 | 3 | 274 | 0.5 | 2.6 | 4.2 | 0.5 | 76 | 91.8 | 15 | Manifold 3 |  | Flow Rate: 1.4 USGPM |  |  |  |  |  |  |  |  |  | Room | Zone | Attachment Method | Tube Type | Loop Number | Area | Unit Heat | Spacing Leader | Loop Length | Flow Rate | Head Loss | Valve Turns | Cover R.V. | Surface Temp. | Water Temp. | Temp Drop | Entry | 3 | Embedded | PEX 1/2" | 1 | 117 | 15.0 | 9 | 3 | 162 | 0.3 | 0.5 | 2.98 | 0.5 | 75.5 | 90.5 | 15 | Living Room | 3 | Embedded | PEX 1/2" | 2 | 166.5 | 15.0 | 9 | 3 | 228 | 0.4 | <p><b>TUBING INSTALLATION</b></p> <p>1. Tube spacing shall not vary by more than 10% from that shown on plans.</p> <p>2. Tubing shall be pressure tested at 100 psi or to 50 psig greater than the operating pressure, whichever is greater, for 30 minutes prior to and during pouring of concrete. System to be tested with air to insure freeze protection. A 30-40 psi pressure test shall remain during phases of construction. Required test shall be conducted by the owner or contractor in the presence of an authorized inspector. The piping being tested shall remain exposed during the test.</p> <p>3. Installer is responsible for protecting tubing from freezing during construction and adding load-freeze and corrosion inhibiting fluids upon completion of work.</p> <p>4. Tubing to be tied or stapled every 3' in straight runs. At the 180-degree turns, staple the tubing at the top of the arc, and once on each side, 12 inches from the top of the arc.</p> <p>5. Installer to record length of every pipe and photograph completed installation (before concrete).</p> <p>6. Refer to manufacturer's guidelines for additional installation methods of their products.</p> <p>7. Tubing for radiant floor heating shall be 1/2" PEX with oxygen diffusion barrier meeting CSA B137+5 certification and listed by IBC to ASTM F-876-93 and F-877-93 and listed by NSF to NSF 61.</p> |  |
| Manifold 1    |                       | Flow Rate: 1.1 USGPM   |                                     |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Room          | Zone                  | Attachment Method  | Tube Type                           | Loop Number  | Area  | Unit Heat          | Spacing Leader     | Loop Length | Flow Rate | Head Loss | Valve Turns | Cover R.V.         | Surface Temp.   | Water Temp.  | Temp Drop |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Game Room     | 1                     | Embedded   | PEX 1/2"                            | 1  | 173.3 | 21.0               | 9                  | 3           | 237       | 0.6       | 2.9         | 4.2                | 0.5   | 78.5   | 98.5      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Game Room     | 1                     | Embedded   | PEX 1/2"                            | 2  | 173.0 | 21.0               | 9                  | 3           | 237       | 0.6       | 2.9         | 4.2                | 0.5   | 78.5   | 98.5      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Manifold 2    |                       | Flow Rate: 3.2 USGPM   |                                     |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Room          | Zone                  | Attachment Method  | Tube Type                           | Loop Number  | Area  | Unit Heat          | Spacing Leader     | Loop Length | Flow Rate | Head Loss | Valve Turns | Cover R.V.         | Surface Temp.   | Water Temp.  | Temp Drop |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Bed 4         | 2                     | Embedded   | PEX 1/2"                            | 1  | 138   | 16.0               | 9                  | 3           | 190       | 0.3       | 0.5         | 2.91               | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Bed 4         | 2                     | Embedded   | PEX 1/2"                            | 2  | 138   | 16.0               | 9                  | 3           | 190       | 0.3       | 0.9         | 2.91               | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Dining Room   | 2                     | Embedded   | PEX 1/2"                            | 3  | 186   | 12.0               | 9                  | 3           | 254       | 0.3       | 1.2         | 3.89               | 0.5   | 74   | 86.5      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Entry         | 2                     | Embedded   | PEX 1/2"                            | 4  | 186   | 12.0               | 9                  | 3           | 254       | 0.3       | 1.2         | 3.89               | 0.5   | 74   | 86.5      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Kitchen       | 2                     | Embedded   | PEX 1/2"                            | 5  | 147   | 16.0               | 9                  | 3           | 202       | 0.4       | 1.1         | 3.11               | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Laundry       | 2                     | Embedded   | PEX 1/2"                            | 6  | 171   | 16.0               | 9                  | 3           | 234       | 0.4       | 1.7         | 3.59               | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Family        | 2                     | Embedded   | PEX 1/2"                            | 7  | 201   | 16.0               | 9                  | 3           | 274       | 0.5       | 2.6         | 4.2                | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Family        | 2                     | Embedded   | PEX 1/2"                            | 8  | 201   | 16.0               | 9                  | 3           | 274       | 0.5       | 2.6         | 4.2                | 0.5   | 76   | 91.8      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Manifold 3    |                       | Flow Rate: 1.4 USGPM   |                                     |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Room          | Zone                  | Attachment Method  | Tube Type                           | Loop Number  | Area  | Unit Heat          | Spacing Leader     | Loop Length | Flow Rate | Head Loss | Valve Turns | Cover R.V.         | Surface Temp.   | Water Temp.  | Temp Drop |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Entry         | 3                     | Embedded   | PEX 1/2"                            | 1  | 117   | 15.0               | 9                  | 3           | 162       | 0.3       | 0.5         | 2.98               | 0.5   | 75.5   | 90.5      | 15  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| Living Room   | 3                     | Embedded   | PEX 1/2"                            | 2  | 166.5 | 15.0               | 9                  | 3           | 228       | 0.4       |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>PLUMBING BETWEEN MANIFOLD AND HEAT SOURCE</b></p> <p>1. Type M or L copper tube joined with 90-5 solder shall be used. Pipe in and out of conditioned space shall be insulated to R-4. All ends of pipe shall be reamed. All lines shall be run as direct as possible.</p> <p>2. Install expansion joints as needed and provide clearance around pipe passing through floors and walls.</p> <p>3. Cross-linked polyethylene with an integral oxygen diffusion barrier may be used only when specifically approved by the local building department. Pipe sizing on plans is based on 0.5" O.D. of copper piping. The use of PEX tubing may require upsizing of nominal sizes and should be verified to match the equivalent pressure loss using copper piping.</p>   |                                     |  |       |                    |                    |             |           |           |             |                    |   | <p><b>MANIFOLD INSTALLATION</b></p> <p>1. Manifolds to be plumbed and situated in their final position.</p> <p>2. Manifolds to be installed at least 18" above finished floor.</p> <p>3. Manifolds to be installed with air vents and flow balancing valves. Manifolds shall be equipped with a fully sealing ball or gate valve on the supply and return to allow service. Zone valves or Teletaps (if used) shall be installed on return side of manifolds. Unless otherwise specified, manifolds shall be brass type.</p>   |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>FLUIDS</b></p> <p>1. Hydronic radiant heating systems, open or closed, should be purged and charged with clean water measuring a minimum pH of 7.0.</p> <p>2. Fill water with high mineral content (hardness) over 8-9 grains (150 ppm) should be presoftened or replaced with de-ionized (D.I.) water.</p> <p>3. When applicable, antifreeze shall be of the propylene glycol type. Refer to "Design Summary" for concentrations.</p> <p>4. Where approved, combined, open systems shall utilize approved fixtures, fittings and pipe for both the heating system and the domestic potable water and pressure tested to regulatory limitations for each. A control device shall be installed on the radiant portion of the system to insure periodic circulation to avoid stagnation during off the season.</p> <p>5. No chemical additives shall be used in a combined open system.</p>  |                                     |  |       |                    |                    |             |           |           |             |                    |   | <p><b>SLAB SYSTEM INSTALLATION</b></p> <p>1. No mechanical tubing joint shall be placed in slab.</p> <p>2. Tubing in the slab shall be 2" min below surface.</p> <p>3. Where passing through slab expansion joints, control joints or cold joints, tubing shall be sleeved a min. of 4" on either side or routed below the expansion joint.</p> <p>4. Tubing shall not be installed closer than 6" from any wall plates, brackets, water closets, cabinets, or other fixtures which may be anchored to the floor with metal fasteners or driven by concrete nails.</p> |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>DESIGN ASSUMPTIONS</b></p> <p>1. 25 degrees F outside design temperatures.</p> <p>2. R-19, R-30 and R-42 wall insulation.</p> <p>3. R-38 and R-50 ceiling insulation.</p> <p>4. Double pane windows U-0.35</p> <p>5. (6) Setback thermostats location per Architect or Owner. Installation per guidelines under the Controls section of the "Heat Source Schematic".</p> <p>6. R-value of the floors not to exceed 0.5</p> <p>7. R-12 under slab insulation and R-12 slab edge insulation.</p> <p>8. Air change rate = 0.5</p>   |                                     |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>CHILLED WATER AIR HANDLERS</b></p> <table border="1"> <thead> <tr> <th rowspan="2">MARK</th> <th colspan="2">COOL KBH</th> <th colspan="4">AIR SIDE</th> <th colspan="3">CHILLED WATER SIDE</th> <th colspan="2">MOTOR</th> <th colspan="2">UNIT FLA</th> <th rowspan="2">WT LBS</th> <th rowspan="2">MANUFACTURER AND MODEL</th> <th rowspan="2">COMMENTS</th> </tr> <tr> <th>TC</th> <th>SC</th> <th>CFM</th> <th>ESP</th> <th>OA</th> <th>EAT</th> <th>LAT</th> <th>°F</th> <th>GPM</th> <th>EWT</th> <th>LWT</th> <th>°F</th> <th>MAX PD</th> <th>HP</th> <th>V/P/H</th> </tr> </thead> <tbody> <tr> <td>AH-1</td> <td>54.6</td> <td>-</td> <td>1600</td> <td>0.5</td> <td>-</td> <td>80</td> <td>58.0</td> <td>10</td> <td>45</td> <td>57.0</td> <td>8.7</td> <td>3/4</td> <td>115/1</td> <td>8</td> <td>158</td> <td>ESP LVE-1750 <span style="color:red;">(1)</span></td> </tr> </tbody> </table> <p>(1) HYDRONIC COOLING      (2) PROVIDE VARIABLE SPEED FACTORY PRESSURE TRANSDUCER CONTROL OPTION</p>  |                                     |  |       |                    |                    |             |           |           |             |                    |   | MARK   | COOL KBH  |   | AIR SIDE |  |                |                              | CHILLED WATER SIDE                  |         |                  | MOTOR                        |                                     | UNIT FLA           |                  | WT LBS                 | MANUFACTURER AND MODEL              | COMMENTS    | TC               | SC                           | CFM                                 | ESP         | OA               | EAT                          | LAT                                 | °F         | GPM           | EWT         | LWT   | °F        | MAX PD | HP       | V/P/H    | AH-1 | 54.6  | -    | 1600 | 0.5   | -   | 80   | 58.0 | 10  | 45   | 57.0 | 8.7    | 3/4 | 115/1     | 8  | 158      | ESP LVE-1750 <span style="color:red;">(1)</span> |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| MARK          | COOL KBH              |  | AIR SIDE                            |  |       |                    | CHILLED WATER SIDE |             |           | MOTOR     |             | UNIT FLA           |   |  | WT LBS    | MANUFACTURER AND MODEL  | COMMENTS |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               | TC                    | SC   | CFM                                 | ESP  | OA    | EAT                | LAT                | °F          | GPM       | EWT       | LWT         | °F                 | MAX PD  | HP   |           |   |          | V/P/H  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| AH-1          | 54.6                  | -  | 1600                                | 0.5  | -     | 80                 | 58.0               | 10          | 45        | 57.0      | 8.7         | 3/4                | 115/1   | 8  | 158       | ESP LVE-1750 <span style="color:red;">(1)</span>  |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>FANS</b></p> <table border="1"> <thead> <tr> <th>MARK</th> <th>LOCATION</th> <th>CFM</th> <th>ESP</th> <th>CFM CONT.</th> <th>ESP</th> <th>SONES OR TIP SPEED</th> <th>MOTOR</th> <th>FAN RPM</th> <th>MAX AMPS</th> <th>WATTS</th> <th>WATTS /CFM</th> <th>MANUFACTURER MODEL</th> <th>COMMENTS</th> </tr> </thead> <tbody> <tr> <td>EF-1</td> <td>MASTER BATH</td> <td>80</td> <td>0.25"</td> <td>30</td> <td>0.25"</td> <td>0.3</td> <td>NA</td> <td>120/1</td> <td>889</td> <td>0.08</td> <td>11.8</td> <td>0.2</td> <td>PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span></td> </tr> <tr> <td>EF-2</td> <td>BATH 2</td> <td>80</td> <td>0.25"</td> <td>--</td> <td>0.25"</td> <td>0.3</td> <td>NA</td> <td>120/1</td> <td>889</td> <td>0.08</td> <td>11.8</td> <td>0.2</td> <td>PANASONIC FV-08VF3 <span style="color:red;">(2) (3) (4)</span></td> </tr> <tr> <td>EF-3</td> <td>BATH 3</td> <td>80</td> <td>0.25"</td> <td>30</td> <td>0.25"</td> <td>0.3</td> <td>NA</td> <td>120/1</td> <td>889</td> <td>0.08</td> <td>11.8</td> <td>0.2</td> <td>PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span></td> </tr> <tr> <td>EF-4</td> <td>BATH 4</td> <td>80</td> <td>0.25"</td> <td>30</td> <td>0.25"</td> <td>0.3</td> <td>NA</td> <td>120/1</td> <td>889</td> <td>0.08</td> <td>11.8</td> <td>0.2</td> <td>PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span></td> </tr> <tr> <td>EF-5</td> <td>LAUNDRY</td> <td>50</td> <td>0.25"</td> <td>--</td> <td>0.25"</td> <td>0.7</td> <td>NA</td> <td>120/1</td> <td>815</td> <td>0.12</td> <td>14</td> <td>0.2</td> <td>PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span></td> </tr> <tr> <td>EF-6</td> <td>GARAGE BATH</td> <td>50</td> <td>0.25"</td> <td>--</td> <td>0.25"</td> <td>0.7</td> <td>NA</td> <td>120/1</td> <td>815</td> <td>0.12</td> <td>14</td> <td>0.2</td> <td>PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span></td> </tr> </tbody> </table> <p>(1) CEC IAQ REQUIRED VENTILATION--DO NOT MODIFY<br/> <span style="color:red;">(2) PROVIDE LUTRON OCCUPANCY SENSOR MODEL # MS-OPSSAM, OR EQUAL</span><br/> <span style="color:red;">(3) PROVIDE HUMIDISTAT CONTROL PER 2010 CAL GREEN CODE SECTION 4.506</span><br/> <span style="color:red;">(4) FAN SHALL BE ENERGY STAR RATED AND HAVE BUILT IN BACKDRAFT DAMPER</span></p>  |                                     |  |       |                    |                    |             |           |           |             |                    |   | MARK   | LOCATION  | CFM   | ESP      | CFM CONT.  | ESP            | SONES OR TIP SPEED           | MOTOR                               | FAN RPM | MAX AMPS         | WATTS                        | WATTS /CFM                          | MANUFACTURER MODEL | COMMENTS         | EF-1                   | MASTER BATH                         | 80          | 0.25"            | 30                           | 0.25"                               | 0.3         | NA               | 120/1                        | 889                                 | 0.08       | 11.8          | 0.2         | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> | EF-2      | BATH 2 | 80       | 0.25"    | --   | 0.25" | 0.3  | NA   | 120/1 | 889 | 0.08 | 11.8 | 0.2 | PANASONIC FV-08VF3 <span style="color:red;">(2) (3) (4)</span> | EF-3 | BATH 3 | 80  | 0.25"     | 30 | 0.25"    | 0.3  | NA | 120/1 | 889  | 0.08 | 11.8 | 0.2 | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> | EF-4 | BATH 4 | 80  | 0.25" | 30   | 0.25" | 0.3        | NA | 120/1                | 889 | 0.08 | 11.8 | 0.2 | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> | EF-5 | LAUNDRY | 50 | 0.25" | --   | 0.25" | 0.7               | NA        | 120/1       | 815  | 0.12      | 14             | 0.2         | PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span> | EF-6      | GARAGE BATH | 50         | 0.25"         | --          | 0.25"     | 0.7   | NA | 120/1    | 815      | 0.12 | 14  | 0.2  | PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span> |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| MARK          | LOCATION              | CFM  | ESP                                 | CFM CONT.  | ESP   | SONES OR TIP SPEED | MOTOR              | FAN RPM     | MAX AMPS  | WATTS     | WATTS /CFM  | MANUFACTURER MODEL | COMMENTS  |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-1          | MASTER BATH           | 80   | 0.25"                               | 30   | 0.25" | 0.3                | NA                 | 120/1       | 889       | 0.08      | 11.8        | 0.2                | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-2          | BATH 2                | 80   | 0.25"                               | --   | 0.25" | 0.3                | NA                 | 120/1       | 889       | 0.08      | 11.8        | 0.2                | PANASONIC FV-08VF3 <span style="color:red;">(2) (3) (4)</span>      |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-3          | BATH 3                | 80   | 0.25"                               | 30   | 0.25" | 0.3                | NA                 | 120/1       | 889       | 0.08      | 11.8        | 0.2                | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-4          | BATH 4                | 80   | 0.25"                               | 30   | 0.25" | 0.3                | NA                 | 120/1       | 889       | 0.08      | 11.8        | 0.2                | PANASONIC FV-08VKMS <span style="color:red;">(1) (2) (3) (4)</span> |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-5          | LAUNDRY               | 50   | 0.25"                               | --   | 0.25" | 0.7                | NA                 | 120/1       | 815       | 0.12      | 14          | 0.2                | PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span>          |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| EF-6          | GARAGE BATH           | 50   | 0.25"                               | --   | 0.25" | 0.7                | NA                 | 120/1       | 815       | 0.12      | 14          | 0.2                | PANASONIC FV-05VF2 <span style="color:red;">(3) (4)</span>          |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       | <p><b>REGISTERS</b></p> <table border="1"> <thead> <tr> <th>MARK</th> <th>TYPE</th> <th>MANUFACTURER MODEL</th> <th>COMMENTS</th> </tr> </thead> <tbody> <tr> <td>CR</td> <td>CEILING RETURN</td> <td>TITUS CT-480 3 26 N 00-000 0</td> <td><span style="color:red;">(1)</span></td> </tr> <tr> <td>CD</td> <td>CEILING DIFFUSER</td> <td>TITUS CT-480 3 26 N 00-000 0</td> <td><span style="color:red;">(1)</span></td> </tr> <tr> <td>CD-2</td> <td>CEILING DIFFUSER</td> <td>MCD 00 x 00 1 00 00-00</td> <td><span style="color:red;">(1)</span></td> </tr> <tr> <td>HSB</td> <td>HIGH SIDE RETURN</td> <td>TITUS CT-480 3 26 N 00-000 0</td> <td><span style="color:red;">(1)</span></td> </tr> <tr> <td>HSS</td> <td>HIGH SIDE SUPPLY</td> <td>TITUS CT-480 3 26 N 00-000 0</td> <td><span style="color:red;">(1)</span></td> </tr> </tbody> </table> <p>(1) PROVIDE MILL FINISH OR CUSTOM PAINT COLOR SPECIFIED BY ARCH.</p>   |                                     |  |       |                    |                    |             |           |           |             |                    |   | MARK   | TYPE      | MANUFACTURER MODEL  | COMMENTS | CR   | CEILING RETURN | TITUS CT-480 3 26 N 00-000 0 | <span style="color:red;">(1)</span> | CD      | CEILING DIFFUSER | TITUS CT-480 3 26 N 00-000 0 | <span style="color:red;">(1)</span> | CD-2               | CEILING DIFFUSER | MCD 00 x 00 1 00 00-00 | <span style="color:red;">(1)</span> | HSB         | HIGH SIDE RETURN | TITUS CT-480 3 26 N 00-000 0 | <span style="color:red;">(1)</span> | HSS         | HIGH SIDE SUPPLY | TITUS CT-480 3 26 N 00-000 0 | <span style="color:red;">(1)</span> |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| MARK          | TYPE                  | MANUFACTURER MODEL   | COMMENTS                            |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| CR            | CEILING RETURN        | TITUS CT-480 3 26 N 00-000 0   | <span style="color:red;">(1)</span> |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| CD            | CEILING DIFFUSER      | TITUS CT-480 3 26 N 00-000 0   | <span style="color:red;">(1)</span> |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| CD-2          | CEILING DIFFUSER      | MCD 00 x 00 1 00 00-00   | <span style="color:red;">(1)</span> |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| HSB           | HIGH SIDE RETURN      | TITUS CT-480 3 26 N 00-000 0   | <span style="color:red;">(1)</span> |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
| HSS           | HIGH SIDE SUPPLY      | TITUS CT-480 3 26 N 00-000 0   | <span style="color:red;">(1)</span> |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |
|               |                       |  |                                     |  |       |                    |                    |             |           |           |             |                    |   |  |           |   |          |  |                |                              |                                     |         |                  |                              |                                     |                    |                  |                        |                                     |             |                  |                              |                                     |             |                  |                              |                                     |            |               |             |   |           |        |          |          |      |       |      |      |       |     |      |      |     |  |      |        |     |           |    |          |  |    |       |      |      |      |     |   |      |        |     |       |      |       |            |    |                      |     |      |      |     |   |      |         |    |       |      |       |                   |           |             |      |           |                |             |  |           |             |            |               |             |           |       |    |          |          |      |     |      |  |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |             |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |       |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |         |   |          |          |   |     |      |   |   |     |     |     |      |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |        |   |          |          |   |     |      |   |   |     |     |     |     |     |    |      |    |            |  |                      |  |  |  |  |  |  |  |  |  |      |      |                   |           |             |      |           |                |             |           |           |             |            |               |             |           |       |   |          |          |   |     |      |   |   |     |     |     |      |     |      |      |    |             |   |          |          |   |       |      |   |   |     |     |  |  |